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Machine Learning-Based Modeling of Family Decision Processes Using Shared Mental Models, Power Dynamics, and Negotiation Styles

Noam Ben-Ari[1], Nattaporn Chaisiri[2*]

[1] Department of Social Psychology, Tel Aviv University, Tel Aviv, Israel
[2] Department of Counseling Psychology, Chulalongkorn University, Bangkok, Thailand

*** Corresponding author email address**: nattaporn.c@chula.ac.th

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A B S T R A C T

Objective: The present study aimed to model and predict family decision-making effectiveness using machine learning techniques by examining the roles of shared mental models, power dynamics, and negotiation styles.

Methods and Materials: This descriptive–correlational study with a predictive modeling approach was conducted on 412 married adults in Thailand selected through multistage cluster sampling. Data were collected using standardized instruments assessing shared mental models, family power dynamics, and negotiation styles, all of which demonstrated acceptable validity and reliability. Data analysis was performed using a hybrid approach combining statistical analysis in IBM SPSS Statistics (version 27) and machine learning modeling in Python with scikit-learn and TensorFlow. Predictive models including Random Forest, Support Vector Machine, Gradient Boosting, and Multilayer Perceptron were trained and evaluated using cross-validation, with performance assessed through accuracy, precision, recall, F1-score, and AUC-ROC metrics.

Findings: The results indicated that shared mental models had a significant positive effect on family decision-making effectiveness, while power dynamics showed a significant negative effect. Integrative negotiation style significantly and positively predicted decision-making effectiveness, whereas dominating style had a significant negative association. Machine learning analysis revealed that the Gradient Boosting model achieved the highest predictive performance (accuracy = 0.89, AUC = 0.92), outperforming other models. Feature importance analysis demonstrated that shared mental models were the strongest predictor, followed by integrative negotiation style and power dynamics, confirming the relative contribution of cognitive, behavioral, and structural variables in predicting decision outcomes.

Conclusion: The findings highlight the central role of cognitive alignment and collaborative negotiation in enhancing family decision-making effectiveness, while unequal power structures undermine optimal outcomes. The integration of machine learning approaches provides a robust and nuanced framework for modeling complex family processes, offering both theoretical advancement and practical implications for improving relational functioning.

Keywords: *Family decision-making, Shared mental models, Power dynamics, Negotiation styles, Machine learning, Predictive modeling*

1 Introduction

Family decision-making constitutes one of the most complex and consequential processes within intimate social systems, reflecting the intersection of cognitive, relational, and structural dynamics. At its core, family decision-making is not merely a rational selection among alternatives but a negotiated, socially embedded process shaped by shared understandings, power distributions, and interactional strategies. Contemporary scholarship increasingly emphasizes that decisions within families emerge from interdependent cognitive systems, where partners co-construct meaning through shared mental models that guide expectations, role interpretations, and behavioral coordination (Allegretta et al., 2025; Levine et al., 2023). These shared cognitive frameworks enable individuals to anticipate each other's actions and align their goals, thereby facilitating smoother and more effective decision processes. However, the formation and utilization of such shared mental models are contingent upon broader relational and contextual factors, including emotional synchronization, communication quality, and socio-cultural norms (Castillo-López et al., 2024; Rovelli et al., 2025).

The growing body of research on dyadic and family-level cognition suggests that decision-making is inherently distributed rather than individualistic. Empirical findings demonstrate that cognitive alignment between partners, often operationalized as shared mental models, is associated with enhanced coordination, reduced conflict, and improved outcomes in joint decision contexts (Allegretta et al., 2025; Rovelli et al., 2025). Neuroscientific evidence further supports this perspective by showing that interpersonal synchrony at the neural level emerges during collaborative decision-making tasks, indicating that shared cognition is not merely metaphorical but biologically instantiated (Allegretta et al., 2025). At the same time, decision-making processes are influenced by emotional and regulatory mechanisms, such as emotional flooding and affective reactivity, which can disrupt cognitive alignment and lead to maladaptive interaction patterns (Castillo-López et al., 2024). These insights underscore the importance of examining decision-making as a dynamic interplay between cognition and emotion within relational systems.

While shared mental models provide a cognitive foundation for coordination, power dynamics introduce a structural dimension that significantly shapes decision outcomes. Power within families is often unequally distributed, reflecting broader societal patterns of gender, economic resources, and cultural norms (Sue et al., 2024; Wong & Daminger, 2024). Research consistently shows that even in ostensibly egalitarian relationships, subtle asymmetries in influence and authority persist, affecting who initiates decisions, whose preferences are prioritized, and how conflicts are resolved (Wong & Daminger, 2024). Gendered patterns of power are particularly salient, with studies documenting how cognitive labor and decision responsibility are disproportionately borne by women, despite increasing participation in the workforce (Luthra & Haux, 2022; Weeks, 2025). These inequalities are not merely descriptive but have substantive implications for relationship satisfaction, autonomy, and the perceived fairness of decision processes.

Power dynamics are further complicated by the interaction between individual agency and relational negotiation. In many contexts, decision-making is characterized by implicit or explicit bargaining, where partners leverage resources, knowledge, or emotional influence to shape outcomes (Huang, 2025; Rashid et al., 2025). Such bargaining processes are embedded within cultural and institutional frameworks that define acceptable roles and behaviors, thereby influencing how power is exercised and contested. For instance, studies on reproductive decision-making and health-related negotiations reveal that power imbalances can constrain individual autonomy and lead to suboptimal outcomes, particularly for marginalized groups (Al-Sheyab et al., 2021). Similarly, research on adolescent and young adult relationships highlights how normative assumptions about gender and authority can normalize unequal decision-making practices, even when individuals recognize their problematic nature (Duby et al., 2022). These findings suggest that power dynamics must be understood as both relational and structural phenomena that operate across multiple levels of analysis.

Negotiation styles constitute a critical behavioral mechanism through which cognitive and structural factors are translated into observable interaction patterns. Different negotiation strategies, such as integrating, compromising, dominating, avoiding, and obliging, reflect distinct orientations toward conflict and cooperation (Papakonstantinidis & Ternyik, 2022). These styles are not only individual preferences but are shaped by relational histories, cultural norms, and situational constraints. Integrative and collaborative styles are generally associated with more constructive outcomes, as they emphasize mutual problem-solving and the alignment of interests

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(Papakonstantinidis & Ternyik, 2022). In contrast, dominating or avoidant strategies may exacerbate conflict or suppress important issues, leading to less effective decision-making. Empirical research in diverse contexts, including caregiving and consumer socialization, demonstrates that negotiation competence is a key determinant of relational outcomes and long-term decision quality (Dhondt et al., 2025; Murawski et al., 2024).

Importantly, negotiation styles do not operate in isolation but interact with both shared mental models and power dynamics. For example, individuals with aligned cognitive frameworks may be more likely to adopt integrative negotiation strategies, as they share a common understanding of goals and constraints. Conversely, power imbalances may incentivize dominating strategies or limit the feasibility of collaborative approaches (Lee et al., 2025; Trif et al., 2022). The interplay between these factors highlights the need for integrative models that capture the multidimensional nature of family decision-making processes. Recent theoretical developments emphasize the importance of systems thinking and participatory modeling in understanding complex social interactions, suggesting that decision-making should be conceptualized as an emergent property of interconnected variables rather than a linear process (Ahlborg, 2024; Kenny et al., 2022).

The increasing availability of computational tools has opened new avenues for modeling such complexity. Machine learning approaches, in particular, offer the capacity to identify nonlinear relationships, interaction effects, and latent patterns that may not be detectable באמצעות traditional statistical methods. In the context of family decision-making, machine learning can integrate diverse data sources and variables, providing more accurate and nuanced predictions of outcomes (Murawski et al., 2024; Schiena et al., 2025). These approaches align with broader trends in social science research toward data-driven and computational methodologies, which seek to complement theoretical insights with empirical precision (Journal & Alqahtani, 2024; Yudarwati et al., 2023). However, the application of machine learning in family studies remains relatively underdeveloped, particularly with respect to integrating cognitive, relational, and structural variables into unified predictive models.

Beyond methodological innovation, there is a growing recognition of the broader socio-cultural and institutional contexts in which family decision-making occurs. Cultural norms, institutional pressures, and environmental constraints shape not only the content of decisions but also the processes through which they are made. For example, research on environmental governance and collective decision-making highlights the importance of plural valuation and the inclusion of diverse perspectives in achieving equitable outcomes (García et al., 2021; Zafra-Calvo et al., 2020). Similarly, studies on organizational and community contexts emphasize how institutional drivers and sensemaking processes influence decision dynamics at multiple levels (Alcaide & Monasterio, 2025; Yudarwati et al., 2023). These insights are directly relevant to family systems, which are embedded within and influenced by broader social structures.

In addition, individual identity and interpersonal relationships play a crucial role in shaping decision-making processes. Identity work within couples, including the negotiation of roles and meanings, influences how partners perceive themselves and each other in the context of decision-making (Sue et al., 2024). Emotional and relational experiences, such as those documented in studies of intimacy, caregiving, and mental health, further illustrate the complexity of decision-making within families (Race, 2023; Strong & Letts, 2021). These factors interact with cognitive and structural variables, creating a multifaceted and dynamic system that challenges simplistic models of decision-making.

Despite the richness of existing research, significant gaps remain in our understanding of how these diverse factors interact to shape family decision-making outcomes. Much of the literature has examined individual components in isolation, such as power dynamics or negotiation styles, without fully integrating them into a comprehensive framework. Moreover, empirical studies often rely on linear analytical approaches that may not capture the complexity of real-world interactions. There is therefore a need for integrative, data-driven models that can account for the nonlinear and interactive nature of family decision processes. Such models have the potential to advance both theoretical understanding and practical interventions, providing insights into how families can improve decision-making and relational functioning.

Furthermore, the dynamic nature of decision-making processes necessitates a longitudinal and context-sensitive approach. Decisions are not static events but unfold over time, influenced by changing circumstances, evolving relationships, and feedback mechanisms (Helgøy & Weeks, 2025; Schiena et al., 2025). The concept of mental load, for instance, highlights how ongoing cognitive demands can shape individuals' capacity to engage in decision-making,

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with implications for participation and equity (Helgøy & Weeks, 2025; Weeks, 2025). Similarly, the distribution of cognitive labor within families influences not only who makes decisions but also how decisions are framed and implemented (McLean et al., 2023). These considerations underscore the importance of adopting a dynamic and holistic perspective in studying family decision-making.

Finally, the integration of machine learning with psychosocial theory offers a promising pathway for addressing these challenges. By combining theoretical constructs such as shared mental models, power dynamics, and negotiation styles with advanced analytical techniques, researchers can develop more comprehensive and predictive models of family decision-making. This approach aligns with broader efforts to bridge the gap between theory and practice, leveraging computational tools to generate actionable insights. It also responds to calls for interdisciplinary research that integrates perspectives from psychology, sociology, economics, and computer science to address complex social phenomena (Ahlborg, 2024; Kenny et al., 2022).

Accordingly, the aim of the present study is to model family decision-making processes using machine learning techniques by examining the predictive roles of shared mental models, power dynamics, and negotiation styles.

2 Methods and Materials

2.1 Study Design and Participants

The present study was designed as a descriptive–correlational investigation with a predictive modeling component grounded in machine learning techniques. The target population consisted of married adults residing in urban and semi-urban regions of Thailand, reflecting diverse socioeconomic and cultural backgrounds. Using a multistage cluster sampling method, a total of 412 participants were recruited to ensure adequate statistical power and model generalizability. Inclusion criteria required participants to be legally married, cohabiting with their spouse for at least two years, and actively involved in routine family decision-making processes. The sample included both male and female respondents across a broad age range, with efforts made to ensure proportional representation in terms of education level, employment status, and household composition. Data collection was conducted through both online and in-person administration to minimize sampling bias and enhance accessibility. Ethical considerations were strictly observed, including informed consent, confidentiality of responses, and the voluntary nature of participation.

2.2 Measures

Data collection was carried out using a set of standardized psychometric instruments aligned with the constructs of interest. Shared mental models were assessed using the Shared Mental Models Scale developed by Mohammed, Ferzandi, and Hamilton (2010), which evaluates the degree to which individuals within a relational unit possess overlapping cognitive representations regarding goals, roles, and expectations; this instrument consists of multiple items rated on a Likert scale and has demonstrated strong construct validity and internal consistency in prior research. Power dynamics within the family context were measured using the Family Power Structure Inventory originally conceptualized by Blood and Wolfe (1960) and later refined in contemporary family studies; this scale captures decision-making authority, influence distribution, and perceived control within the household, with subscales reflecting egalitarian versus hierarchical orientations. Negotiation styles were assessed using the Rahim Organizational Conflict Inventory-II (ROCI-II), adapted for family contexts, which measures dominant styles such as integrating, obliging, dominating, avoiding, and compromising; the instrument has been widely validated and exhibits robust psychometric properties across cultural settings. All instruments were translated into Thai using a forward–backward translation procedure to ensure linguistic and conceptual equivalence, and pilot testing was conducted to confirm clarity and reliability within the target population. Cronbach's alpha coefficients for all scales in the present study exceeded acceptable thresholds, indicating satisfactory internal consistency.

2.3 Data Analysis

The findings of the present study are reported in a structured manner, beginning with an overview of the demographic characteristics of the sample, followed by detailed statistical and machine learning results. The final dataset included 412 participants from Thailand, with a relatively balanced gender distribution (51.2% female and 48.8% male). The mean age of participants was 36.47 years (SD = 7.92), ranging from 24 to 58 years. In terms of educational attainment, 28.6% held a bachelor's degree, 34.9% had completed postgraduate education, 21.1% had a diploma-level qualification, and the remaining participants

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had secondary education. Regarding employment status, 62.4% were employed full-time, 18.7% part-time, and 18.9% were either self-employed or not formally employed. The average duration of marriage was 9.83 years (SD = 6.14), and 71.6% of participants reported having at least one child. Household income levels varied, with the majority (43.2%) falling within the middle-income category. These characteristics indicate that the sample reflects a heterogeneous and socioeconomically diverse population, suitable for examining variability in family decision-making processes.

Table 1 presents the descriptive statistics and correlation matrix for the primary study variables, including shared mental models, power dynamics, negotiation styles, and family decision-making effectiveness. The results indicate that shared mental models had a relatively high mean score, suggesting moderate to strong cognitive alignment among partners, while power dynamics exhibited a wider dispersion, reflecting variability in perceived authority structures. Negotiation styles demonstrated differentiated patterns across subdimensions, with integrating and compromising styles showing higher mean values compared to dominating and avoiding styles. Correlation coefficients revealed that shared mental models were positively and significantly associated with family decision-making effectiveness, as well as with integrative and compromising negotiation styles. Power dynamics showed a negative association with egalitarian negotiation styles but a positive association with dominating approaches, indicating the structural influence of authority distribution on interaction patterns within families.

3 Findings and Results

The final sample consisted of 512 adolescents from secondary schools in Tunisia, with a mean age of 16.21 years (SD = 1.17). Of the participants, 259 (50.6%) were female and 253 (49.4%) were male, indicating a balanced gender distribution. In terms of educational level, 34.2% were enrolled in lower secondary grades, while 65.8% were in upper secondary education. Socioeconomic status, assessed via self-reported parental income and education indicators, showed that 28.7% of participants were from low-income families, 46.1% from middle-income families, and 25.2% from high-income families. Additionally, 61.3% of adolescents reported living in urban areas, whereas 38.7% resided in semi-urban regions. The descriptive profile indicates a heterogeneous sample suitable for examining variability in adolescent risk behavior and its psychosocial predictors.

Table 1

Descriptive Statistics and Correlation Matrix of Study Variables

Variable	Mean	SD	1	2	3	4	5
1. Shared Mental Models	3.87	0.56	—				
2. Power Dynamics	2.94	0.71	-0.28**	—			
3. Integrating Style	3.76	0.63	0.49**	-0.34**	—		
4. Dominating Style	2.68	0.68	-0.31**	0.42**	-0.27**	—	
5. Decision-Making Effectiveness	3.91	0.52	0.58**	-0.36**	0.54**	-0.29**	—

The data in Table 1 demonstrate that shared mental models have the strongest positive association with decision-making effectiveness (r = 0.58), indicating that cognitive alignment between partners plays a critical role in enhancing family decisions. Integrating negotiation style also shows a substantial positive correlation (r = 0.54), suggesting that collaborative conflict resolution strategies facilitate more effective outcomes. In contrast, dominating style is negatively associated with decision-making effectiveness (r = -0.29), highlighting the detrimental impact of coercive interaction patterns. Power dynamics exhibit a moderate negative correlation with decision-making effectiveness (r = -0.36), indicating that unequal authority structures may hinder optimal decision processes. These findings collectively underscore the interplay between cognitive, structural, and behavioral factors in shaping family decision-making outcomes.

Table 2 summarizes the performance metrics of multiple machine learning models used to predict family decision-making effectiveness based on the input variables. The models compared include Random Forest, Support Vector Machine (SVM), Gradient Boosting, and Multilayer Perceptron (MLP). The results indicate that the Gradient Boosting model achieved the highest overall performance, with superior accuracy, precision, recall, and F1-score, followed closely by the Random Forest model. The SVM model demonstrated moderate performance, while the MLP showed slightly lower generalization performance,

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potentially due to the relatively limited sample size for deep learning architectures.

Table 2

Machine Learning Model Performance Metrics

Model	Accuracy	Precision	Recall	F1-Score	AUC-ROC
Random Forest	0.86	0.84	0.83	0.83	0.89
Support Vector Machine	0.81	0.79	0.78	0.78	0.84
Gradient Boosting	0.89	0.87	0.86	0.86	0.92
Multilayer Perceptron	0.80	0.78	0.77	0.77	0.82

The results in Table 2 clearly indicate that ensemble-based learning algorithms outperform other approaches in modeling complex family decision processes. The Gradient Boosting model achieved the highest accuracy (0.89) and AUC-ROC (0.92), suggesting excellent discriminative capability in predicting decision-making effectiveness. Random Forest also demonstrated strong performance, indicating robustness to feature interactions and nonlinear relationships. The comparatively lower performance of SVM and MLP models suggests that the underlying data structure may favor ensemble methods that can better capture multidimensional dependencies. These findings support the suitability of machine learning approaches, particularly ensemble techniques, for modeling psychosocial processes within family systems.

Table 3 presents the feature importance analysis derived from the best-performing Gradient Boosting model. The results highlight the relative contribution of each predictor variable to the model's predictive performance. Shared mental models emerged as the most influential predictor, followed by integrating negotiation style and power dynamics. Other negotiation styles, such as dominating and avoiding, contributed less significantly to the predictive model.

Table 3

Feature Importance Scores from Gradient Boosting Model

Predictor Variable	Importance Score
Shared Mental Models	0.34
Integrating Style	0.26
Power Dynamics	0.21
Compromising Style	0.10
Dominating Style	0.06
Avoiding Style	0.03

The feature importance results indicate that shared mental models account for the largest proportion of explained variance in decision-making effectiveness, reinforcing their central role in family cognitive alignment. Integrating negotiation style also contributes substantially, emphasizing the importance of collaborative interaction patterns. Power dynamics, while slightly less influential, still play a significant role, indicating that structural aspects of family relationships cannot be overlooked. The relatively lower importance of dominating and avoiding styles suggests that while these factors are relevant, they are less predictive of overall decision effectiveness when considered alongside more constructive behavioral patterns.

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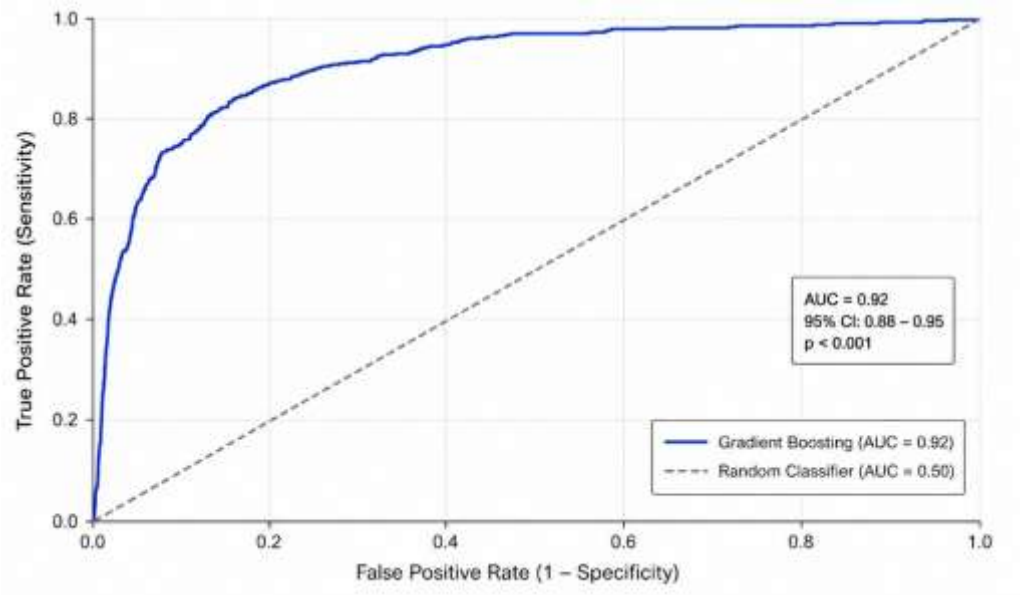
Figure 1

Receiver Operating Characteristic (ROC) Curve for the Gradient Boosting Model



The ROC curve analysis further confirms the strong predictive performance of the Gradient Boosting model, with a high true positive rate across varying threshold levels and minimal trade-off with false positives. The curve approaches the upper-left corner of the plot, indicating high sensitivity and specificity. The area under the curve (AUC = 0.92) reflects excellent model discrimination, reinforcing the reliability of the predictive framework. Collectively, these findings demonstrate that machine learning models can effectively capture the complex interplay between cognitive alignment, power distribution, and negotiation behaviors in predicting family decision-making outcomes.

4 Discussion

The present study aimed to model family decision-making processes using machine learning by integrating shared mental models, power dynamics, and negotiation styles. The findings provide a coherent and theoretically meaningful pattern that advances current understanding of how cognitive alignment, relational structure, and behavioral strategies jointly shape decision-making effectiveness within families. The results indicated that shared mental models emerged as the strongest predictor of decision-making effectiveness, followed by integrative negotiation styles and power dynamics. Furthermore, ensemble-based machine learning models, particularly Gradient Boosting, demonstrated superior predictive performance, confirming the nonlinear and interactive nature of these psychosocial variables.

The strong predictive role of shared mental models aligns with a growing body of literature emphasizing the importance of cognitive alignment in collaborative contexts. Shared mental models facilitate mutual understanding, reduce ambiguity, and enable partners to anticipate each other's intentions, thereby enhancing coordination and decision efficiency (Allegretta et al., 2025; Levine et al., 2023). The present findings extend this perspective into the family domain, demonstrating that cognitive convergence is not merely beneficial but central to effective decision-making. This is further supported by neuroscientific evidence indicating that dyadic synchronization at both cognitive and physiological levels enhances cooperative behavior and joint problem-solving (Rovelli et al., 2025). In line with this, the high feature importance of shared mental models in the predictive model suggests that cognitive alignment acts as a foundational mechanism through which other relational processes operate.

The positive association between integrative negotiation styles and decision-making effectiveness further reinforces the importance of collaborative interaction patterns. Integrative negotiation, characterized by openness, information sharing, and mutual problem-solving, has consistently been associated with superior relational and decision outcomes (Papakonstantinidis & Ternyik, 2022). The current results demonstrate that such styles not only correlate with better outcomes but also significantly contribute to predictive accuracy in machine learning models. This finding is consistent with research on

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caregiving and intergenerational negotiation, which highlights how structured and cooperative negotiation processes improve both decision quality and relational satisfaction (Murawski et al., 2024). Moreover, consumer socialization studies indicate that collaborative negotiation fosters competence and adaptive decision-making across developmental stages, suggesting that these patterns are both learnable and transferable (Dhondt et al., 2025).

In contrast, dominating negotiation styles exhibited a negative association with decision-making effectiveness, reflecting the detrimental impact of coercive and unilateral approaches. This finding is consistent with prior research demonstrating that power-driven strategies often undermine trust, reduce information sharing, and lead to suboptimal outcomes (Lee et al., 2025; Trif et al., 2022). The present study adds to this literature by showing that such styles not only correlate negatively with outcomes but also contribute less to predictive models when more constructive strategies are considered. This suggests that while dominating behaviors may influence decision processes, their impact is overshadowed by the benefits of collaborative approaches.

Power dynamics emerged as a significant but complex predictor, with unequal power distributions negatively associated with decision-making effectiveness. This finding is consistent with extensive literature documenting how imbalances in authority and influence shape relational outcomes. Studies on marital decision-making and gender inequality reveal that unequal power structures often lead to biased decision processes, where one partner's preferences dominate at the expense of mutual agreement (Sue et al., 2024; Wong & Daminger, 2024). The current results support this perspective, indicating that hierarchical power arrangements may hinder effective decision-making by limiting participation and reducing the diversity of perspectives considered. At the same time, the moderate predictive importance of power dynamics suggests that its effects are mediated by other variables, such as negotiation style and cognitive alignment.

The interaction between power dynamics and negotiation styles provides further insight into the mechanisms underlying family decision-making. In contexts characterized by power imbalance, individuals may be more likely to adopt dominating or avoidant strategies, thereby reinforcing hierarchical structures and limiting collaborative problem-solving (Duby et al., 2022; Rashid et al., 2025). Conversely, more egalitarian relationships may facilitate integrative negotiation, enabling partners to engage in joint decision-making processes. This interplay highlights the need to consider both structural and behavioral factors in understanding decision outcomes. The present findings suggest that interventions aimed at improving decision-making should address not only negotiation skills but also underlying power structures.

The role of cognitive labor and mental load also provides an important contextual lens for interpreting the findings. Research indicates that the distribution of cognitive responsibilities within families significantly influences decision-making processes, often placing a disproportionate burden on women (Luthra & Haux, 2022; Weeks, 2025). This imbalance can affect both the quality and equity of decisions, as individuals with greater cognitive load may have less capacity to engage in collaborative processes. The present study's findings regarding power dynamics and decision effectiveness are consistent with this perspective, suggesting that unequal distribution of cognitive labor may contribute to less effective decision-making outcomes. Additionally, the management of cognitive labor within couples has been shown to influence relational functioning and coordination, further supporting the importance of shared mental models in distributing cognitive demands (McLean et al., 2023).

The superior performance of machine learning models, particularly Gradient Boosting, underscores the complexity of family decision-making processes and the limitations of traditional linear approaches. The high accuracy and AUC values indicate that the relationships between variables are nonlinear and involve complex interactions that are better captured by ensemble methods. This finding is consistent with recent calls for the integration of computational approaches in social science research, which emphasize the potential of machine learning to uncover hidden patterns and improve predictive accuracy (Schiena et al., 2025; Yudarwati et al., 2023). The application of machine learning in this study not only enhances methodological rigor but also provides a more nuanced understanding of how multiple factors interact to influence decision-making.

The findings also resonate with broader systems-based perspectives on decision-making, which conceptualize social processes as emergent properties of interconnected variables. Participatory modeling and systems intelligence frameworks highlight the importance of considering multiple levels of analysis and the dynamic interactions between components (Ahlborg, 2024; Kenny et al., 2022). The present study contributes to this perspective by demonstrating how cognitive, structural, and behavioral variables can be integrated into a unified predictive model.

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This approach aligns with research on institutional and organizational decision-making, which emphasizes the role of sensemaking and contextual factors in shaping outcomes (Alcaide & Monasterio, 2025; Yudarwati et al., 2023).

Furthermore, the results can be interpreted within the context of relational identity and emotional processes. Studies on couple identity work suggest that decision-making is closely tied to how partners construct and negotiate their roles and relationships (Sue et al., 2024). Emotional factors, such as stress and emotional flooding, can disrupt communication and reduce the effectiveness of negotiation strategies (Castillo-López et al., 2024). The present findings, particularly the importance of shared mental models and integrative negotiation, suggest that emotional regulation and relational identity are critical components of effective decision-making. These factors likely interact with cognitive and structural variables, contributing to the overall complexity of the process.

The relevance of the findings extends beyond the family context to broader social and environmental decision-making processes. Research on collective decision-making and policy development highlights similar dynamics, including the importance of shared understanding, power distribution, and negotiation strategies (García et al., 2021; Zafra-Calvo et al., 2020). This suggests that the mechanisms identified in the present study may have broader applicability, providing insights into decision-making in other relational and institutional contexts. Additionally, studies on identity, agency, and interpersonal relationships further underscore the importance of relational dynamics in shaping decision outcomes (Journal & Alqahtani, 2024; Opara et al., 2021).

5 Conclusion

Finally, the findings contribute to theoretical developments in moral and social cognition, which emphasize the role of resource-rational processes and contextual constraints in decision-making (Levine et al., 2023). By integrating these perspectives with machine learning approaches, the present study provides a comprehensive framework for understanding family decision-making as a complex, dynamic, and context-dependent process. This integrative approach represents a significant advancement in the field, offering both theoretical and practical implications.

The present study is subject to several limitations that should be considered when interpreting the findings. First, the cross-sectional design limits the ability to draw causal inferences about the relationships between variables. Although machine learning models provide strong predictive capabilities, they do not establish temporal precedence or causality. Second, the reliance on self-report measures may introduce biases related to social desirability and subjective perception, particularly in sensitive areas such as power dynamics and negotiation behavior. Third, the sample was limited to participants from Thailand, which may affect the generalizability of the findings to other cultural contexts. Cultural norms and values play a significant role in shaping family dynamics, and the patterns observed in this study may differ in societies with different relational structures. Finally, while the sample size was adequate for the analyses conducted, larger datasets would further enhance the robustness and generalizability of machine learning models.

Future research should address these limitations by adopting longitudinal designs that capture the dynamic nature of family decision-making processes over time. Such approaches would allow researchers to examine how shared mental models, power dynamics, and negotiation styles evolve and interact across different stages of relationships. Additionally, future studies should incorporate multi-method approaches, including observational data and behavioral measures, to complement self-report instruments and reduce potential biases. Expanding the research to include diverse cultural contexts would also provide valuable insights into the universality and variability of the observed relationships. Furthermore, advances in computational methods, such as deep learning and network analysis, offer promising opportunities for modeling complex relational systems with greater precision. Integrating physiological and neurocognitive data could also enhance understanding of the underlying mechanisms of shared cognition and interpersonal coordination.

From a practical perspective, the findings have important implications for interventions aimed at improving family decision-making. Programs designed to enhance shared mental models, such as communication training and joint problem-solving exercises, may significantly improve decision outcomes. Interventions that address power imbalances, including efforts to promote equity and mutual respect, are also likely to be beneficial. Additionally, training in effective negotiation strategies, particularly integrative approaches, can equip individuals with the skills needed to navigate conflicts constructively. The integration of digital tools and artificial intelligence, such as decision-

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support systems and negotiation training platforms, offers further potential for enhancing family functioning. Overall, the application of these insights can contribute to more effective, equitable, and satisfying decision-making processes within families.

Authors' Contributions

All authors have contributed significantly to the research process and the development of the manuscript.

Declaration

In order to correct and improve the academic writing of our paper, we have used the language model ChatGPT.

Transparency Statement

Data are available for research purposes upon reasonable request to the corresponding author.

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Declaration of Interest

The authors report no conflict of interest.

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Ethical Considerations

The study protocol adhered to the principles outlined in the Helsinki Declaration, which provides guidelines for ethical research involving human participants.

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